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IS 12448-2-2 (1988): General Examination, Electrical Continuity and Contact Resistance tests, Insulation Tests and Voltage Stress Tests, Section 2: Electrical [LITD 3: Electromechanical Components and Mechanical Structures for Electronic Equipment]



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“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

BASIC TESTING PROCEDURES AND MEASURING METHODS FOR ELECTROMECHANICAL COMPONENTS FOR ELECTRONIC EQUIPMENT

PART 2 GENERAL EXAMINATION, ELECTRICAL CONTINUITY AND CONTACT RESISTANCE TESTS, INSULATION TESTS AND VOLTAGE STRESS TESTS

Section 2 Electrical Continuity and Contact Resistance Tests

1. Scope — This standard (Part 2/Sec 2) covers methods to measure electrical continuity and contact resistance.

2. Test 2a: Contact Resistance — Millivolt Level Method

2.1 Object — The object of this test is to detail a standard method to measure the electrical resistance across a pair of mated contacts or a contact with a measuring gauge.

2.2 General Measuring Requirements — Measurements may be carried out with direct current or alternating current. For ac measurements, the frequency shall not exceed 2 kHz. In the case of dispute, the dc measurements shall govern.

The accuracy of the measuring apparatus shall be such that the total error does not exceed 10 percent.

2.3 Method of Measurement

2.3.1 Measurement details — The contact resistance shall be derived normally from the voltage drop measured between the zones intended for connection of the wiring to the contacts at the points specified in the detail specification.

The contact shall not be operated while the measuring voltage is applied. Care must be taken during the measurement to avoid exerting abnormal pressure on the contacts under test and to avoid movement of the test cables.

While the connection points specified in the detail specification are not directly accessible, the resistance of the cable or wire used shall be subtracted from the measured value. The corrected value shall be recorded.

The contacts to be measured shall be chosen in accordance with the detail specification.

2.3.2 Test current and voltage — In order to prevent the breakdown of insulating films on the contacts, the emf of the measuring circuit shall not exceed 20 mV dc or ac peak, open circuit.

The test current shall not exceed 100 mA ac or dc.

2.4 Measuring Cycles

*Reference Code: BIS-SJCE-STEP
Standards Information Centre, Mysore*

2.4.1 Measurement with direct current — One measuring cycle consists of:

- a) making the contact,
- b) application of the voltage,
- c) measurement with current flowing in one direction,
- d) measurement with current flowing in the opposite direction,
- e) disconnection of the voltage source, and
- f) breaking the contact.

2.4.2 Measurement with alternating current — One measuring cycle consists of:

- a) making the contact,
- b) application of the voltage,

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- c) making the measurement,
- d) disconnection of the voltage source, and
- e) breaking the contact.

2.4.3 More than one measuring cycle — When two or more measuring cycles are required by the detail specification, they shall be carried out in immediate succession.

Note — Unless otherwise specified, the made contact(s) should not be disturbed between the end of the preceding test and the application of the voltage in this test, nor between successive measuring cycles.

2.5 Requirements

2.5.1 The value of the contact resistance shall not exceed, for any measurement, the value specified in the detail specification.

2.5.2 The contact resistance measurement with dc shall be the average of the two readings obtained with forward and reverse current.

Note — Any deviation from the standard test procedure should be clearly indicated in the test report.

2.6 Details to be Specified — When this test is required by the detail specification, the following details shall be specified:

- a) The connecting point of the measuring wires, their type and size, if applicable;
- b) For mated sets, the contacts to be measured and the number of measuring cycles;
- c) For individual mated contacts, the number of contacts to be measured and the number of measuring cycles;
- d) Whether contacts are to be operated before the measurements and/or between the measuring cycles;
- e) The permissible limits of contact resistance; and
- f) Any deviation from the standard test method and/or conditions.

3. Test 2b: Contact Resistance — Specified Test Current Method

3.1 Object — The object of this test is to detail a standard method to measure the electrical resistance across a pair of mated contacts or a contact with a measuring gauge.

3.2 General Measuring Requirements — Measurements may be carried out with direct current or alternating current. For ac measurements, the frequency shall not exceed 2 kHz. In the case of dispute, the dc measurements shall govern.

The accuracy of the measuring apparatus shall be such that the total error does not exceed 10 percent.

3.3 Method of Measurement

3.3.1 Measurement details — The contact resistance shall be derived normally from the voltage drop measured between the zones intended for connection of the wiring to the contacts at the points specified in the detail specification.

The contact shall not be operated while the measuring voltage is applied.

Care must be taken during the measurement to avoid exerting abnormal pressure on the contacts under test and to avoid movement of the test cables.

Where the connection points specified in the detail specification are not directly accessible, the resistance of the cable or wire used shall be subtracted from the measured value. The corrected value shall be recorded.

The contacts to be measured shall be chosen in accordance with the detail specification.

3.3.2 Test current and voltage — The contact resistance shall be measured with the rated alternating current or direct current as specified in the detail specification. The emf of the source shall not exceed 60 V dc or ac peak, but shall be at least 1 V, as specified in the detail specification.

Measurements shall be made on individual contacts within minutes following application of the test current.

3.4 Measuring Cycles

3.4.1 Measurement with direct current — One measuring cycle consists of:

- a) making the contact,
- b) application of the voltage,
- c) measurement with current flowing in one direction,
- d) measurement with current flowing in the opposite direction,
- e) disconnection of the voltage source, and
- f) breaking the contact.

Note — Unless otherwise specified, the made contacts should not be disturbed between the end of a preceding test and the application of the voltage in this test, nor between successive measuring cycles.

3.4.2 Measurement with alternating current — One measuring cycle consists of:

- a) making the contact,
- b) application of the voltage,
- c) making the measurement,
- d) disconnection of the voltage source, and
- e) breaking the contact.

Note — Unless otherwise specified, the made contacts should not be disturbed between the end of a preceding test and the application of the voltage in this test, nor between successive measuring cycles.

3.4.3 More than one measuring cycle — When two or more measuring cycles are required by the detail specification, they shall be carried out in immediate succession.

3.5 Requirements — The value of the contact resistance shall not exceed for any measurement, the value of which is specified in the detail specification.

The contact resistance measurement with dc shall be the average of the two readings obtained with forward and reverse current.

Note — Any deviation from the standard test procedure should be clearly indicated in the test report.

3.6 Details to be Specified — When this test is required by the detail specification, the following details shall be specified:

- a) The connecting point of the measuring wires, their type and size, if applicable;
- b) For mated sets, the contacts to be measured and the number of measuring cycles;
- c) For individual mated contacts, the number of contacts to be measured and the number of measuring cycles;
- d) Whether contacts are to be operated before the measurements and/or between the measuring cycles;
- e) The measuring current;
- f) The permissible limits of contact resistance; and
- g) Any deviation from the standard test method and/or conditions.

4. Test 2c: Contact Resistance Variation

4.1 Object — The object of this test is to detail a standard method to determine the variation of contact resistance of electromechanical components under specified dynamic conditions. This test shall be carried out only on components, the contact resistance of which is measured by Test 2a.

4.2 Mounting of the Test Specimen — The test specimen shall be mounted in accordance with the requirements of the detail specification.

4.3 General Requirements

4.3.1 The variation of contact resistance shall be determined under dynamic conditions.

4.3.2 The measurement of variation of contact resistance shall be made during the period specified in the relevant test and/or detail specification.

4.3.3 The measurement shall be made with a dc not exceeding 50 mA and the emf of the measuring circuit shall not exceed 20 mV.

4.3.4 The variation of contact resistance shall not exceed the value specified in the detail specification.

4.4 Measuring Apparatus

4.4.1 The variation of contact resistance may be determined by means of a cathode-ray oscilloscope (with a long-persistence screen) displaying the voltage drop measured between points specified in the detail specification.

4.4.2 The measuring apparatus shall have a frequency characteristic which is flat within ± 3 dB between 400 Hz and 1 MHz; and if an oscilloscope is used, it shall have a sensitivity as follows:

- a) 50 μ V/cm or better, up to 1 MHz, when measuring resistances up to 5 m Ω ;
- b) 500 μ V/cm or better, up to 1 MHz, when measuring resistances up to 30 m Ω ; and
- c) 1.0 m V/cm or better, up to 1 MHz, when measuring resistances above 30 m Ω .

4.5 Detail to be Specified — When this test is required by the detail specification, the following details shall be specified:

- a) method of mounting and wiring the test specimen and details of the cable/wire bundle to be used,
- b) limit of variation of the contact resistance,
- c) severity of the associated dynamic test(s),
- d) contacts to be measured,
- e) sensitivity of the measuring apparatus, and
- f) any deviation from the standard test method and/or conditions.

5. Test 2e: Contact Disturbance

5.1 Object — The object of this test is to detail a standard method for detecting contact disturbance of electromechanical components under specified dynamic conditions.

5.2 Mounting of the Test Specimen — The test specimen shall be mounted in accordance with the requirements of the detail specification.

5.3 Method of Measurement

5.3.1 The contact disturbance shall be determined under dynamic conditions. The duration of the opening of closed contacts and/or the closing of open contacts shall be determined when the component is subjected to bump, shock, vibration or acceleration tests.

5.3.2 The monitoring of contact disturbance shall be made during the period specified in the relevant test and/or detail specification. The contacts may be monitored individually or in one or more groups as specified in the detail specification. When monitored in groups, closed, contacts may be connected in series and open contacts may be connected in parallel.

Note — If failure is indicated when testing contacts in groups, it is permitted to test individual contacts subsequently.

5.4 Requirements

5.4.1 The measurement shall be made with dc not exceeding 150 mA. The emf of the source shall not exceed 10 V.

5.4.2 The duration of the contact disturbance shall not exceed the value specified in the relevant test and/or detail specification. Preferred values are 1 μ s, 10 μ s, 100 μ s, 1 ms and 10 ms.

5.4.3 A closed contact is considered disturbed when the voltage across it exceeds 50 percent of the source emf. An open contact is considered disturbed when the voltage across it drops below 50 percent of the source emf.

5.5 Details to be Specified — When this test is required by the detail specification, the following details shall be specified:

- a) Method of mounting and wiring the test specimen and details of the cable/wire bundle to be used;
- b) Monitoring period, if different from that specified in the relevant test method;
- c) Contacts to be monitored and their operated condition;

- d) Limit of duration of contact disturbance; and
- e) Any deviation from the standard test method and/or conditions.

6. Test 2f: Housing (Shell) Electrical Continuity

6.1 Object — The object of this test is to detail a standard method for measuring the resistance between component housing (shells) which are intended to provide electrical continuity, when mated.

This test is not intended to ensure shielding against magnetic or rf interference.

6.2 General Requirements

6.2.1 Components having metallic housings (shells) intended to provide electrical continuity, when mated shall be tested as follows:

- a) Measurements shall be made on mated sets of components, and
- b) Free components shall be fitted with short lengths of wire of cable as specified in the detail specification.

6.2.2 The resistance shall be measured through all joints connected in series such as:

- a) From cable braid and/or housing (shell) to mounting panel where one of the components is a fixed type,
- b) Between cable braids for free components, and
- c) Between mounting panels where both connectors are fixed.

6.2.3 The resistance measurements shall be made according to Test 2b.

6.3 Testing Requirements — The value of the resistance shall not exceed the value specified in the detail specification.

6.4 Details to be Specified — When this test is required by the detail specified:

- a) method of mounting the specimen and the associated cable(s) wire bundle(s),
- b) points at which measurements are to be made,
- c) test current and test method (Test 2b or Test 2c) to be used,
- d) maximum permissible resistance, and
- e) any deviation from the standard test method and/or conditions.

7. Test 2h: Resistance (Earthing) from Actuator to Mounting Bushing (Surface)

7.1 Object — The object of this test is to detail a standard method to determine the resistance between a metal switch actuator and the mounting bushing in which it operates.

7.2 Method of Measurement — Connections shall be between suitable exterior points on the switch actuator and the mounting bushing. The actuator shall have no external force applied to it during measurement of resistance.

One complete cycle of the actuator may be made prior to test. Actuations during test shall be limited to the minimum movement necessary to put the actuator into its next reading position.

Resistance measurements shall be made in each of two actuator positions, as far apart as possible for rotary switches; at each normal actuator position for level switches; or as specified in the detail specification.

One resistance measurement shall be made in each actuator test position. Resistance shall be measured in accordance with Test 2a.

7.3 Requirements — The value of resistance shall not exceed for any measurement, the value of which is specified in the detail specification.

7.4 Details to be Specified — When this test is required by the detail specification, the following details shall be given:

- a) measurement positions of actuator, if other than that specified in 7.2,
- b) maximum allowable resistance, and
- c) any deviation from the standard test method.

EXPLANATORY NOTE

This standard (Part 2/Sec 2) is based, without any technical change, on IEC Pub 512-2 (1985) 'Electromechanical components for electronic equipment; Basic testing procedures and measuring methods: Part 2 General examination, electrical continuity and contact resistance tests, insulation tests and voltage stress test', issued by the International Electrotechnical Commission (IEC).